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Review and Critique

of

Oil Shale Tract C-a

Detailed Development Plan

Volumes I and II

Submitted to the Area Oil Shale Supervisor

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by

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Summary of Review and Critique

This critique addresses the characteristics of mine development, construction and operation with specific reference to the adequacy of correlating biotic data obtained from baseline surveys with the predicted impacts of these surveys. In addition particular attention was given to the adequacy of impact assessment and the development of future mitigation and monitoring plans.

I found that in some cases nebulous terms were used instead of specific criteria defined so that operators could identify actions needed, proceed with the action and be able to ascertain when the finished product or goal was obtained. Writing objectives in terms of performance throughout the plan would help eliminate this problem.

One weakness in the DDP is that the final judgment of the overall impact of the project on the Piceance Basin's ecosystem would be negligible. This may be the case if tract C-a were the only development, however, the cumulative impacts from all concurrent development activity in the basin might have considerably more impact. Thus, I feel that impacts in relation to other developments should be evaluated. In addition the data substantiating the position of negligible impact is not presented in such a way that this thesis is adequately supported.

Another major shortcoming is that the entire plan is based upon off-tract support facilities and dump sites. If

this is not approved by the Department of Interior, there is no evaluation as to an alternative action. Alternatives could be to proceed with all on-tract development or abandon the project. These alternatives need to be evaluated.

A major shortcoming is that baseline data sample sizes are inadequate to provide reliable estimates, then in monitoring programs plans are to cut back on sample sizes when in reality sampling should be intensified. This will preclude any possible evaluation of development effects upon the specific parameters estimated.

There are many generalized statements needing supportive data which when checked in the annual report we find it is inadequate data due either to poor statistical design or poor choice of methodology. For example, there is no way of estimating deer densities or deer distributions using the methods RBOSP has chosen. Deer pellet group surveys have inadequate sample sizes and aerial surveys using fixed wing aircraft will not provide density estimates.

I would rather the reporters admit the data is lacking rather than make us think it is just fine.

Volume 1 - Project Background and Executive Summary

General Comments:

This is an excellent overview of the proposed project and projected impacts. Volume 1 provides enough detail to be useful and yet is a sufficient summary so nontechnical persons can rapidly gain a concept of the project. There are some areas, however, where additional detail would be useful. I would particularly like to see a bit more detail in proposed analysis techniques for parameters to be measured in monitoring programs. I suggest that data should be identified as to expected usefulness in detecting differences between baseline conditions and future conditions. Those data expected not to yield significant results should be evaluated as to their usefulness in future monitoring programs.

Specific Comments: Section 2, Executive Summary --

Project Overview, Chapter 1

P. 2-1-2, PP4: In sentence two, I agree with most of the baseline ecological data collected; however, with deer populations there are ways to compare the data to long-term averages or trends. This is one of the shortcomings of the baseline data collection program since it is accepted by local state wildlife management and research personnel that in 1974-75 the deer population was at least 30-50 percent

below carrying capacity as demonstrated by long-term-
harvest trends and population estimates.

P. 2-1-15: Tract C-a to Rangely Access Road -- This plan assumes that if the access road will be built then construction will progress in an orderly fashion. In my opinion, there are other constraints that need to be considered. For example, if economic considerations demand a no-go decision after construction of the road, the result is an unwanted, undesirable road. In order to insure environmental safeguards, this access road should not continue. The question needing to be answered before road construction is: What are the probabilities of not-
developing tract C-a and what constraints will lead to this decision? A similar situation occurs with the potential construction of the power transmission line from the White River, although the environmental effects are less severe.

Baseline Conditions, Chapter 3

P. 2-3-8, PP1: Reference needed for statement that the tract does not contain any exceptional natural, archaeological or historical sites.

P. 2-3-41, PP5: Is this overall browse use of all species? Perhaps the species should be named.

Processed Shale and Overburden Disposal, Chapter 7

P. 2-7-6, PP4: Guidelines for the final configuration of the disposal pile should be given. Topography, slope and aspect are important ecologic considerations, and the

carrying capacity numbers which would have been relevant to death.

good point!

design should consider future wildlife habitat enhancement.

P. 2-7-8: Overburden should be separated into topsoil, subsoil and mineral earth. Specifications as to handling should be summarized here.

Support Facilities, Chapter 8

P. 2-8-4: Apparently, an alternative of tying in with Tract C-b and Colony's proposed pipeline has not been considered. In my opinion, we still need to see an overall development of dual-use facilities where possible.

Environmental Protection, Health and Safety, Chapter 9

P. 2-9-17: Land Rehabilitation and Erosion Control - The Land should also be returned to wildlife habitat capable of supporting similar species and biomass that it is now supporting. What is environmental deterioration? What are surrounding aesthetic values? Can they be measured? In paragraph 5, page 2-9-17, a fourth environmental concern should be added: "the species and biomass of wildlife to be supported."

P. 2-9-19, PP3: What criteria determines if nutrients will be added to restore fertility to stockpiled topsoil?

P. 2-9-21, PP1: What criteria will be used for decisions to spread large rocks in the slope roughening treatment?

P. 2-9-27, PP3: Has RBOSP considered releasing from employment workers receiving wildlife violations for poaching or attempted poaching?

P. 2-9-30, PP2: What is reasonably acceptable habitat for wildlife, and who makes the decision it is acceptable?

P. 2-9-32: Is breaking up asphalt sufficient to preclude environmental degradation? I suggest it is not.

P. 2-9-33, PP2: What plan is to be enacted for reclaiming support facilities such as roads, powerlines and pipelines?

Assessment, Chapter 10

P. 2-10-3, PP4: Mitigation in the form of water augmentation sounds good, but where does the water come from and what are the effects of using foreign water as a result of collection, removal and transportation?

Monitoring, Chapter 11

P. 2-11-10: Flora - The phytosociological transect should be tested during initial stages for adequacy of sample size in each enhancement area. *ye*

P. 2-11-11: Fauna - Included in a description of techniques it would be well to state statistical tests to be used or refer to the section detailing such tests and to identify which studies could be expected to show significant differences. Certain of the data should be identified as having only the potential of providing relative values that are not conducive to statistical treatment. In addition the level of precision should be stated for those data amenable to statistical treatment, i.e., do the investigators expect data to show significant results at a probability of ±10 percent of the mean at the 90 percent confidence level

or ±20 percent of the mean at the 95 percent confidence level?

P. 2-11-16, PP4: Will these techniques provide large enough samples to show significant differences from baseline data?

P. 2-11-18, PP4: How does the experimental test program for revegetation fit into the wildlife management plan?

Volume 2 - Baseline Conditions (Book 2 of 2)

Terrestrial Ecology, Chapter 7

P. 3-7-6 - 3-7-21: Have these vegetative associations been described by other workers? If so, literature citations are needed.

P. 3-7-14: Sagebrush - I would like to see a taxonomic study to differentiate species and/or sub-species of big sagebrush within the various associations and soil types. This highly complex and variable taxonomic group is an extremely important genus to the ecology of the basin. To understand revegetation needs, big game preferences, and successional status, it is important to know the different species, sub-species and ecotypes which various workers have reported as being limited to specific soil types and elevations.

P. 3-7-17: Greasewood - Is the greasewood association a disclimax caused by excessive grazing in the past which

resulted in increased erosion, lowered water tables and invasions of greasewood? This thesis has been proposed by some U. S. Soil Conservation Service workers and may be an area of needed investigation since further lowering of water tables resulting from dewatering of the mine is a possibility and could cause permanent vegetative changes similar to the greasewood association.

P. 3-7-21, PP2: A grazing exclosure cannot of itself demonstrate or monitor vegetation responses; however, studies can be designed so that investigators can demonstrate changes in vegetation, composition, density cover, frequency, etc. Minor changes of this paragraph should be made so that the objectives can be stated with greater precision and in terms of performance.

PP5 and PP6: Please provide a brief summary of parameters to be measured and expected analyses techniques so that the statistical design can be evaluated in terms of the stated objectives. The level of precision expected should be stated. What is the null hypothesis? How often or what intervals will subsequent measurements be taken? What will the effects of mining, plant construction, etc., be upon this site? How do the objectives relate to baseline data monitoring? Is the replicated area outside the mine influence area to be used as a control?

P. 3-7-25: Discussion - A third hypothesis in evaluation of the results of range, soil and browse condition

and trend should be considered. It is possible that the methodology is not adequate to show what is really happening in the various habitats evaluated. The ratings of poor to excellent for range condition and trend relate only to the present vegetative community in correlation with palatability and preference of plants in this particular method. A major shortcoming is that successional status in terms of climax communities is not identified or evaluated by the methodology proposed. Communities should not be classified only as range sites, rather they should be habitat types capable of supporting a particular association of plants. The community is either stable or changing. If the change is toward a homeostatic condition, then the trend is good since the ultimate effect will be a decrease in soil loss and a more stable ecosystem. If the trend is toward a less stable community, then this should be identified. For example, the pinon pine - Utah juniper woodland association may represent the most stable community in the area. It may have the greatest productivity in terms of biomass and yet when evaluated by the U.S. Forest Service range-condition and trend method which focuses upon increaser and decreaser forage plants, the community is readily classified in poor condition. In reality, the trend may be stable. The community may be in near climax state and soil losses are most likely minimal. Carrying capacity, however, is very low and will not change unless

no way to
prove -
this is a research
successional
study. 1

impossible
in 2 years

climax yes
minimal soil
loss no

the community is manipulated to a lower level of succession which has more forage species in the composition. I would suggest that these communities be evaluated in terms of their successional status and their trend toward or away from a homeostatic condition.

P. 3-7-28, PP4? The objectives are nebulous and not stated in terms of performance. I would suggest objectives stated as:

1. Measure forage production of grasses, forbs and browse plants in pounds per acre (grams per hectare) ± 10 percent of the mean at the 90 percent confidence level.
2. Measure the percent utilization of current annual production of selected forage species by cattle, horses, mule deer and elk at the termination of the growing season on or after September 5 and before October 1 at a level of precision of ± 10 percent of the mean at the 90 percent confidence level.
3. Estimate the relative preferences of herbivores in four plant associations by comparing forage utilization values of major forage species.

P. 3-7-29: Discussion - How do these measurements relate to future monitoring? I would like to see an evaluation to suggest future studies, changes, additions and/or deletions. For example, the question might be asked why in the monitoring section was production of biomass estimated by using an electronic capacitance meter for production while in these studies estimates were based

on clip plot measurements? How will the data be compared?

P. 3-7-31: Objectives - Should be more specific and defined in terms of performance and how they relate to the overall program.

P. 3-7-62: Discussion - In this section, data precision as related future measurements and capability of assessing significant changes should be discussed. In addition, projections of data usefulness in future programs should be discussed. Recommendations for technique changes and indicator species to be used in monitoring programs should be made.

P. 3-7-66, PP5: Note whether the aerial flights were fixed wing or helicopter surveys.

P. 3-7-67, PP4: When discussing percentages of deer observed by Gilbert and Grieb (1957), it would be well to compare ground cover and density of trees between Gilbert and Grieb's study area and the Piceance Basin aerial flight areas since there are major differences in the two areas.

P. 3-7-71, PP6: Need documentation of data or literature to back up this statement.

P. 3-7-72, PP1: Need data or references.

P. 3-7-78: Discussion - How will the data be applied in future monitoring studies. Please discuss shortcomings and/or strengths of the data gathered to date.

P. 3-7-89, PP1, Sentence 2: Is it an objective to show the importance of an avian species? How will this be done?

P. 3-7-92, PP4: It would be well to summarize the potential value of these data in regard to utility in monitoring programs. Is the data of sufficient precision to detect differences due to mining perturbations?

P. 3-7-95, last PP: The last sentence is not finished.

P. 3-7-144: Winter tract counts - Is one measurement during the winter adequate to provide meaningful data? Can this technique be used with reliability for future comparisons? A statistical approach is needed in the sampling design so that the replications can be used and an analysis of variance or similar technique be calculated for future testing of differences between mean values. If this is not possible, then occurrence and distribution should be the parameter to be estimated since quantitative relative abundance data would be meaningless.

P. 3-7-152 - 3-7-170: In this discussion we need to see the relevance of these data to the objectives as stated on p. 3-7-152, PP2. Will this data provide a basis for determining the role of invertebrates in the ecosystem? Are there now indications of this role or are further samples needed? Are the present techniques adequate in terms of reliability and precision? How will these data serve in future monitoring and comparative studies? Is the statistical design for sampling adequate? Are there indicator species that will serve as a key to identifying irreversible or severe effects on the ecosystem from mining perturbations?

P. 3-7-183, PP2: In sentence three the statement assumes that all breeding pairs of peregrine falcons were observed. Actually the statement should read that only five known pairs were successful in producing fledglings.

P. 2-7-197, PP2: Need references to substantiate this statement and data reference in annual reports showing where ecotonal measurements have documented this expansion of pinon-juniper vegetation.

P. 3-7-197, PP4: Data is needed to document wild horse seasonal forage utilization. If it is not available, perhaps a recommendation to determine such is needed.

P. 3-7-198, PP1: The first sentence is not complete. Need a reference for the statement.

P. 3-7-198, PP2: How do these literature citations correspond with ecological measurements within the study area? We need to see if the study area is reacting similarly in successional trends.

P. 3-7-199, PP1: Have the investigators checked Bartmann's food habits data? How do these data fit in with Hansen and Dearden's data?

P. 3-7-199, PP3: What data shows that areas east of the tract have the greatest variety of mule deer forage?

PP4: References to wild horse food preferences are needed.

P. 3-7-195 - 204: Producer - Primary Consumer Interactions - In this section, it seems relationships of lagomorphs to each

other and their respective roles in the ecosystem has been overlooked. Habitat use of white-tailed vs. black-tailed jackrabbits in relation to cottontail rabbit use may be important features of the ecosystem to understand when predicting influence of development by vegetative type.

P. 3-7-204, PP3: Generalized references on coyote foods are meaningless since it is highly variable according to prey availability. Did Fautin and Sperry collect their food habits data in similar ecosystems?

P. 3-7-209, PP2: Would this be the place to discuss potential effects of the changes in the ecosystem caused by development of tract C-a?

P. 3-12-1 - 3-12-17: I would like to see a discussion section dealing with the application of these data to stockpiling, redistribution, mixing to create artificial soils and problems with revegetation.

P. 3-14-20, PP3: In the baseline data portions of this document, this relationship was not well documented. Normally, palatable species are browsed detrimentally before less palatable pinons are taken; thus thinning of pinon-juniper stands due to deer browsing seems unlikely and especially to see palatable browse replacing seedling trees.

P. 3-14-16-42, Section 14.3: Ecosystems Interactions - This section is well done and lays the groundwork for further analysis. I would like to see projections of direct application at this point in regard to mining development

activities. For example, can artificial soils be created through mixing of natural available overburden? As a result can specific plant communities be predicted that will enhance desired ecosystem relationships? Perhaps more detail on applications of these ecosystem relationships would be a big help to administrators.

Volume 4 - Environmental Protection and Monitoring

Land Rehabilitation and Erosion Control, Chapter 8

P. 9-8-1, PP1: The objectives are not adequate in terms of actual lease requirements which state that land will be returned to former productivity for similar plants and animals. Land rehabilitation objectives should demonstrate a long range plan designed to insure progressive successional changes in vegetational composition that will insure with a high degree of probability a vegetational complex approaching that of former predisturbance fauna carrying capacity. Specific objectives should be written for this section that will provide performance guidelines for RBOSP so that end products can be identified and rehabilitation work can continue in case of failure of first or second cut efforts and the end product can be obtained. At this point what will the end product look like and produce? How will RBOSP know when they have been successful? Are there different short term and long term objectives for access roads, power lines, drill sites and spent shale piles?

P. 9-8-3: Artificial Soil Profile - It should be mentioned that provisions in stockpiling overburden include separation of materials into rock, subsoil or mineral soil and topsoil. Topsoil should also be defined so that a heavy equipment operator can identify and separate it into district storage piles. References to other sections in the DDP where these criteria are also explained should be made.

P. 9-8-7, PP3: Why is the word "may" used for the possibility of spreading large rocks? If it is a desirable practice, specify the rocks "will" be spread and give specifications as to how it will be done.

P. 9-8-11, PP2: What provisions will be made to insure continued effort if and after initial efforts fail or initial efforts result in an unfavorable vegetation complex (See my comments on objectives for this section, p. 12). Cross referencing to the fish and wildlife management plan would be in order.

P. 9-8-12, PP2: It is good to see these problems brought to light in order to lay the groundwork for "mandatory" use of overburden "and" (not "or") soil over spent shale piles.

P. 9-8-13, PP5? This proposal needs to be correlated with the fish and wildlife plan and the ultimate objective as per vegetation desired. In pile shaping it would be desirable to create micro-habitat sites with different slopes

and aspects. Within these microsites, clones of transplanted shrubs and trees should be established and slope configurations approximating the most desirable habitat use areas for mule deer (see baseline data results) could be emphasized. I would like to see more creativity in revegetation plans as related to the end product desired. This concept will tie in well with the aesthetic plan and should be cross-referenced to section 10.3, Shapes, on p. 9-10-3.

P. 9-8-18, PP1: If the above suggestion is implemented, this paragraph should be changed to show an even greater acceleration of secondary succession as a result of well placed (planned) microsites with clones of shrubs and trees. These clones would be potential seed sources for more rapid successional changes. The microsites might also be the best sites for establishment of native plants in which seed availability precludes extensive use.

P. 9-8-23, PP1: It would be desirable to use sewage sludge produced on the tract and possibly sludge from the new town development at Rangely. With foresight planning, proper handling techniques could be implemented that would solve disposal problems for sewage and provide a ready source of needed fertilizer.

P. 9-8-26, PP4: I would like to see an added experiment using sewage sludge as a possible treatment.

P. 9-8-32, Table 9-8-6: The suitability of these species (especially browse) for wildlife is dependent upon

the location of the seed source and the variety of the species used. For example, the palatability of big sagebrush is highly variable due to essential oil content variations and/or inability to identify species, subspecies or ecotypes. Big sagebrush is often lumped as one species which may or may not be true. Specifications as to location of seed source and ecotype should be made so that seed from plants having moderate to high palatability will be used.

P. 9-8-34, PP2: What data supports the thesis that six inches of Paraho processed shale is adequate to simulate a spent shale pile? What criteria have been used to select the depth of spent shale?

P. 9-8-34: Summary and Conclusions - Since these experiments constitute the revegetation plan, I suggest an experiment be designed to assess the potential of developing microsites as discussed above and transplanting native shrubs and trees with planting of native grasses and forbs.

Aesthetics, Chapter 10

P. 9-10-3, PP2: Cross reference to my proposed discussion (above) on microsite development. Fig. 9-10-3 is a good illustration of how benching and terracing can be used to facilitate this proposal.

P. 9-10-7, PP1: The statement "avoided as much as possible" is very nebulous. Please define criteria as to when clearing will be allowed and prohibit clearing completely except for these rare necessary specifications.

P. 9-10-7, PP4: What is larger vegetation in terms of height?

Fish & Wildlife Plan, Chapter 11

P. 9-11-12, PP2: I disagree with the enhancement proposal for the southeast portion of the tract. As an alternative, the groundwork should be laid now for off-tract enhancement where RBOSP will provide the monetary funds for development to be executed by state and federal agencies. In this way the longest longterm benefit at the lowest investment can be realized. It is my recommendation to go directly into the proposed second stage of habitat development.

P. 9-11-31, last PP: More specific language should be used. For example, "if mine dewatering causes large fluctuation (define large fluctuation) in water levels of the major springs (define major springs), the RBOSP would (will) anticipate (strike anticipate) augmentation (augment)" losses of springwater by developing "x" number of guzzlers located in "y" places (see map).

P. 9-11-32, PP1: Define minor springs by location and name if possible.

P. 9-11-33: Fencing - RBOSP should include in this plan a study design to identify probable deer-vehicle accident locations on all support roads. Techniques designed by Dale Reed, et al, Colorado Division of Wildlife should be used. This is especially important on the

proposed Rangely-Tract C-a access road. As a consequence of this study, fences and deer underpasses should be planned and constructed.

P. 9-11-33: Wildlife Habitat Enhancement and Restoration - It is encouraging to see RBOSP proposing ideas for adjacent habitat areas to be enhanced. I suggest that foresight be used and areas off-tract be identified that have the maximum potential for habitat enhancement. Planning now in cooperation with the State Division of Wildlife and Bureau of Land Management can result in years of time savings rather than implementing on-tract enhancement now to be followed with off-tract enhancement much later in Phase II. RBOSP could cooperate by furnishing funds, equipment and/or manpower for vegetative manipulation. I suggest the acreage and habitat types be determined by calculating the carrying capacity lost and then applying an enhancement potential percentage to the proposed project area. Enough acreage should be treated to potentially replace lost carrying capacity due to road, powerline, drill pad, mine and spoil pile developments. The Colorado Division of Wildlife Mitigation procedure would be a valuable aid in calculating needed treatment acreages. With this procedure nebulous thoughts as expressed in sentence 4, paragraph 1, p. 9-11-34 could be eliminated. It is my opinion that the agencies involved would be eager to cooperate to the fullest extent possible and as rapidly as possible. Provision should be

made for monitoring the enhancement project so that in case the project fails to provide the carrying capacity calculated in pre-project enhancement planning, then additional acreages can be improved to make up the deficit and enable full replacement of habitat values lost. Evaluating the success of a project should be a team effort involving the state and federal agencies and RBOSP personnel.

P. 9-11-35, PP4: I suggest adding the specification that irregular treatment edges be used rather than circular or rectangular treatment boundaries.

P. 9-11-39, PP4: It would be well to include the CDOW in on sagebrush conversion location surveys.

P. 9-11-41, PP5: CDOW personnel should be part of the team selecting water development locations.

P. 9-11-43: Habitat Restoration - This discussion should be skillfully correlated with the Aesthetics plan in Chapter 10 and the Land Rehabilitation and Erosion Control Section in Chapter 8. Slope shape, creation of micro-habitats and selection of plant species to be seeded and transplanted should be cross-referenced and specified here. Since baseline data studies showed mule deer have an affinity for moderately undulating north to northeast slopes these slopes and aspects should be emphasized in the planning of contours, slopes and configuration of the spent shale pile.

P. 9-11-45: Fencing and Underpasses - Monitoring road kills need to be defined as to how, who and when. In addition night spotlight counts along the roadways in accordance with procedures recommended by Dale Reed and/or Tom Woodard, CDOW, will help identify potential road-kill hazard areas as well as underpass and fencing possibilities.

P. 9-11-47, PP2: I would like to see disciplinary actions by RBOSP spelled out in terms of action per type of violation. In this way a supervisor can proceed with an action in an unbiased manner based on specific criteria. Poaching should be one violation that is grounds for dismissal.

P. 9-11-47: Off Road Vehicle Use - I suggest a cooperative transportation plan to be worked out with BLM, CDOW, and AOSS. The details as proposed by RBOSP could be proposed here.

P. 9-11-48: Monitoring Program - Proposed monitoring of vegetation, invertebrates and vertebrates should have sample sizes capable of comparing pre-development with post-development means. Please identify the standard statistical analysis procedures planned for each parameter to be estimated and show what techniques will be used to determine sample sizes.

P. 9-11-52: Small Mammals - Are there specific mammals that should be classified as indicator species and require special monitoring study design?

P. 9-11-53: Sage Grouse - It would be desirable to continue efforts to locate strut grounds and conduct counts within these areas.

P. 9-11-56: Quality Assurance and Administration - The RBOSP Supervisor is referred to as an administrator directing performance of the wildlife management plan. What are the supervisor's other duties and what authority does he or she have in regard to other operations on the tract? What education and experience qualifications must this person have? My recommendation is that the supervisor have line authority and be part of the RBOSP supervisory staff and that five years of administrative experience at the supervisory level in a wildlife related field be required. In addition, it would be desirable to require at least a Master of Science Degree for the position.

P. 9-11-57, PP3: What is an independent regulatory agent? How much authority does the agent have?

P. 9-11-58, PP2: It would be desirable to include other technical staff of BLM, CDOW and WELT, USF&W agencies for evaluation proposed strategy changes.

Abandonment, Chapter 13

P. 9-13-2, PP3: Define a reasonably acceptable habitat for wildlife so the operator and appropriate agencies can identify when a proper job has been accomplished. This could be defined in terms of density of vegetation by species and density and habitat use of animal species on the sites.

Whatever criteria are used should be quantifiable with standard measurement techniques.

P. 9-13-4, PP2: Again revegetation success should be clearly spelled out.

P. 9-13-7, PP1: Obliteration of access roads should be defined as to how it will be accomplished and how further use can be prohibited.

General Comments regarding abandonment - In the event abandonment should occur during Phase I or II, this plan does not address the Rangely to Tract C-a road, or other transportation and/or powerline corridors. It could be that due to economic considerations, oil shale development will reach a stand still. In that case the Rangely access road would not be needed and should be obliterated, revegetated and designed to prohibit further use.

Environmental Assessment, Section 10

Hydrology, Chapter 3

P. 10-3-2: Mitigative Procedures - It would be desirable to see a detail of the adequacy of the proposed water replacement scheme to ascertain if the mitigation will achieve the desired results.

Aquatic Ecology, Chapter 4

P. 10-4-3, PP4: How much water will be pumped?

Please include a detail of pumped water discharges and locations of releases. Also, show if the mitigation effort can completely offset reductions and/or possibly improve present aquatic habitats.

P. 10-4-5, PP1: It is unclear to me if all or some of the surface water supplies will be maintained. The second sentence should be expanded to show what can be expected as a result of mitigation.

P. 10-4-6: Mitigative Procedures - There is a need to refer to a figure detailing aquatic habitats that will be eliminated and show which habitats will have alterations. Irreversible alterations should be described. How will the diversion of flood flows mitigate Cornal Gulch dewatering effects.

- Terrestrial Ecology, Chapter 5

P. 10-5-2, PP3: One of the shortcomings of work done on small mammals is that no specific analysis of probable indicator species was made. Species such as the least chipmunk and deer mouse adaptable and ubiquitous that they could hardly be indicative of the ecosystems initial responses to subtle environmental perturbations which may be forerunners of major impacts. These species are important due to their biomass, however, there may be other species that would be highly important as indicators. It would seem reasonable to re-examine the importance values of small mammals.

P. 10-5-4, PP2: Due to possible shortcomings in the monitoring program, I have already mentioned (sample size limitations and application of statistical tests), the accuracy of impact assessment may not be of sufficient

precision to detect differences. Thus, it is strongly recommended that sampling techniques for monitoring be strengthened to provide data of adequate precision whenever possible.

P. 10-5-4: Impact Assessment - In this discussion and subsequent discussions detailing acreages lost by habitats and phase of development, it would be desirable to show a chart(s) and/or map(s) showing these losses.

P. 10-15-10: Mitigative Procedures - Initiating off-tract vegetative enhancement designed to provide equal amounts of carrying capacity as that lost due to impact is very important at these early stages. Proposed cooperative programs should be detailed here so that negotiations with other agencies can be initiated. These mitigative measures should be carried through to all phases and all impacts.

P. 10-5-33, PP4: Carrying capacity for large mammal herbivores can also be calculated. Even though large mammals may avoid or move to adjacent habitats, these acreage losses still represent real carrying capacity losses and should be included in calculations for habitat enhancement plans designed at increasing carrying capacities to offset these losses. This concept also applies to all of the impact assessments.

P. 10-5-43: Overview - One of the problems with the overview is that it assumes success in revegetation and mitigation efforts. I would also like to see a worse case

examination of interactions in the ecosystem assuming failure of proposed revegetation work. Appraisals of potential efforts on a worse case basis have been good, but these projections need to be carried forth for the reviewer to see both the minimal and maximal impacts. In addition these impacts are considered only as a result of tract C-a development. This will not be the only development in the basin, and the impacts should be evaluated in terms of total Basin development. Previous reports such as the EIS and the Regional Oil Shale Study by Thorne Ecological Institute have taken an overall look at potential basin and regional impacts. There should be some attempt by RBOSP to incorporate their latest findings and mine plan into these comprehensive studies. References to other studies and projects are entirely lacking in this plan and are a great oversight that should be corrected.

Environmental Monitoring Program, Section 11

Terrestrial Ecology, Chapter 4

This analysis is very good with the exception that I see no provision for testing the adequacy of sample sizes for the various parameters to be estimated. If the statistical techniques planned to be used as indicated in Table 11-4-1, p. 11-4-9 are to be successful, adequate sample sizes must be designed.

P. 11-4-27, PP4: What data substantiates this theory? Please demonstrate how deviations from baseline methodology will provide comparable data.

P. 11-4-30, RP1: These survey flights will show distributional changes but will not demonstrate an adequate assessment of mule deer populations. I would recommend that a quadrat sampling technique similar to that of Bartmann's work in the basin would augment CDOW work and provide more meaningful and reliable data for population estimates.

P. 11-4-31, PP2: Will these sample sizes be adequate?
Revegetation, Chapter 7

P. 11-7-1: Criteria for Success - There needs to be a demonstration of persistence to redo portions of revegetation work that have failed. Included in this plan should be criteria that established guidelines for the operator to know when corrective actions should be taken.

Conclusion

The detailed development plan is well written as a summary only and each section within each volume appears to fit into the overall format and objectives. The real problem is that the first year baseline data collections are the result of inadequate sampling design, sampling sizes and data analysis techniques. The second year baseline data collections are now being initiated and there has been no evaluation of needed changes to provide more re-

liable estimates of the various biotic parameters being estimated. Monitoring plans show in most cases reduced sampling intensities and in some cases changed techniques with no data to support these reductions and/or changes.

I believe that in order for this plan to be accepted, the following criteria must be met:

1. Parameters expected to be sensitive to environmental changes should be selected for monitoring.
2. Sample size estimates must be made for each parameter to be estimated.
3. Sampling must be intensified on those parameters judged to be sensitive to environmental impacts.
4. The specific problems I have detailed in this report should be corrected.
5. There should be a greater effort toward:
 - a. measuring meaningful data that relates to oil shale development at a level providing statistically significant estimates.
 - b. monitoring the above at the same level of precision.
 - c. correlation of habitat types, soil types and wildlife use with long term objectives for rehabilitation.
 - d. design rehabilitation efforts to accomplish specific goals stated in terms of end products.

- e. demonstrate a willingness to maintain monitoring and rehabilitation efforts until such goals are realized.
- f. demonstrate a willingness to support and achieve objectives for habitat enhancement outside the influence zone of the mine and support facilities by providing funds, manpower and equipment to work on Federal and State land in cooperation with the responsible agencies.

The ultimate result of the work done on baseline data collection and development plans should be categorized very specifically as:

1. Being able to recognize irretrievable losses of portions of the ecosystem in terms of
 - a. vegetation habitat types
 - b. soil types
 - c. reduced populations of biota (loss of biomass)
 - d. loss of specific species of vegetation and/or animals
2. A plan to replace those losses that are irretrievable or lost for such a long time (30 plus years) that for practical purposes they can be considered lost for the benefit of the present generation by enhancement programs in areas not affected by present development activities.

3. A rehabilitation plan with specific end products designed so that rehabilitation efforts can continue until the objective is reached. This means the end product must be quantifiable by standard available techniques.

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